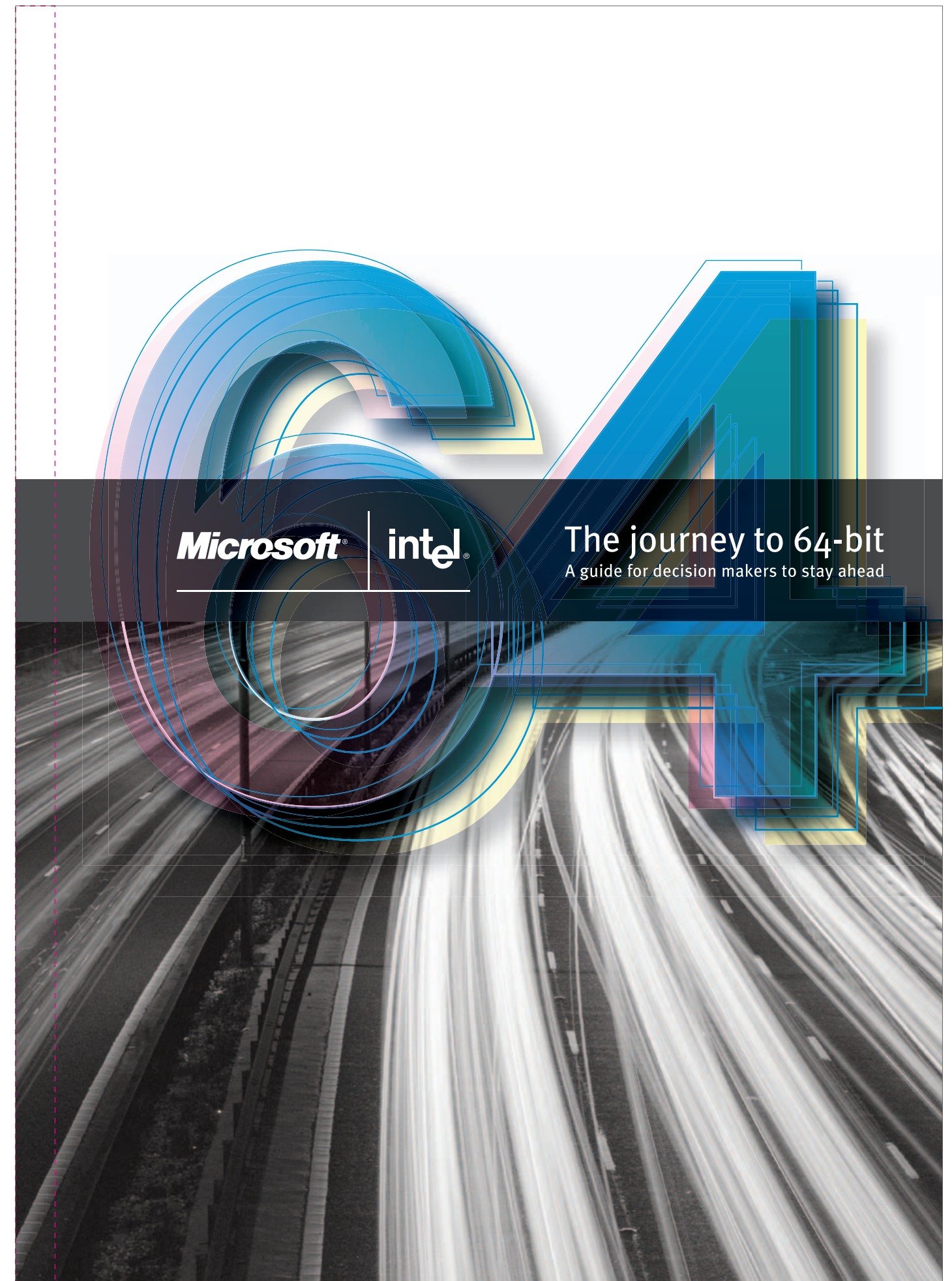




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The demands placed by large enterprises on computing systems today are more complex than ever. Several trends such as increases in subscribers to telecommunications services, outsourcing and integration of supply chains, and growth in business automation solutions have stimulated the development of platforms offering increased reliability and performance. These new platforms are based on multi-core architecture and 64-bit technology.

Multi-core architecture and 64-bit computing carry the promise of ushering in a new era of high performance enterprise computing that can significantly impact your organization's total cost of ownership (TCO) on IT investments, while accelerating product time-to-market for your business.

This guide is designed to help you understand the benefits of multi-core and 64-bit technology. It will also cover how to plan and implement a migration to 64-bit computing based on your specific applications, workloads, IT environment and business drivers.

Confined to a 32-bit world?

Most of today's high volume mainstream server processors manipulate data and instructions in 32-bit chunks. These processors cannot address more than 4GB of memory at a time, and 32-bit operating systems typically can't manage more than about 2GB of memory.

In an environment where business-critical decisions require real-time computing capable of analyzing massive databases, demanding applications are pushing the limits of 32-bit computing. Why?

- Today, enterprises retain and process huge volumes of complex data about vendor and customer interactions, and internal processes, demanding zero-latency computing environments.
- New applications are also increasing the computational intensity and size of data.
- Memory configurations are growing as memory prices fall. Memory in computing devices doubles every couple of years as the price per megabyte of memory continues to drop 50 per cent in the same interval.

The inherent memory limitations of 32-bit systems challenge enterprise productivity and efficiency, making the case for 64-bit systems .

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Explore 64-bit



Does the promise of greater power, reliability and scalability of applications appeal to you? If the answer is 'yes', it is time to explore 64-bit.

The label "64-bit," when applied to a microprocessor simply refers to the number of bits that can be processed in parallel. A 64-bit microprocessor therefore manages data in 64-bit chunks, nearly doubling the potential throughput per operation.

64-bit technology in itself is not a reason to leap and click your heels. It's what an enterprise does with "64-bitness" that makes it interesting. For one thing, it removes the hard limitation of 4GB of flat memory addressing per process. To access more than 4GB at a time, 32-bit processors have to resort to tricks like memory managers and overlays, which significantly affect performance. If the information in your databases is a terabyte (TB) or more, 32-bit can barely meet your needs! For example, accessing more than 4GB data at a time is typical of a data mining application. Richard Lees of EasternMining.com.au in Australia is able to provide analysis of 1 billion rows to Macquarie University and the general public with the aid of Microsoft® SQL Server™ 64-bit edition on an Intel® Itanium® platform. More details can be found at <http://EasternMining.com.au/Demonstrations>. There are several online databases including Macquarie University web logs, EasternMining web logs and the Foodmart sales having over 1 billion rows, with databases updated on hourly, daily and/or weekly schedules. All the databases are continuously available for reporting and ad-hoc analysis through Microsoft® Internet Explorer.

Using 64-bit addressing, servers can directly access as much as 16 exabytes (16 billion gigabytes!) of RAM. No computer today can physically hold this but whether the server supports 16GB or 256GB, a single 64-bit application could access as much RAM as needed.

A 32-bit processor can access about 4GB of physical memory.

A 64-bit processor can access over 1 Petabyte (1000 TB) of physical memory.

$$2^{64} = 1.8446744 \times 10^{19}$$

To put this in perspective, 1 terabyte (TB) is 50 per cent more information than all of the printed material in the Library of Congress.¹

A 64-bit operating system supports far more physical memory than a 32-bit operating system. Most benefits of a 64-bit CPU will go unnoticed without the key components of a 64-bit operating system and 64-bit software and 64-bit drivers which are able to take advantage of 64-bit processor features.

For example, most 32-bit Windows® operating systems support a maximum of 4GB of physical memory, with up to 3GB of address space for each process, while 64-bit Windows® operating systems support up to 1TB of physical memory with 8 TB of address space for each process.

The increased physical memory in the microprocessor translates into the following benefits for applications:

- Each application can store vast amounts of data in the main memory, which can be accessed several times faster compared to the quickest mass-storage subsystems because disk reads are not necessary.
- Each application can support more users. Applications such as CAD/CAM, science and engineering, human resources, online analytical processing (OLAP) and financial modeling requiring large files, a large number of files, or a large number of users will benefit immensely.
- Each application especially large, memory intensive applications that take advantage of this extra capacity can see dramatic performance increases. Increased physical memory allows more applications to reside in the system's main memory and run simultaneously. This reduces or eliminates the performance penalty of swapping pages to and from disk.
- Since a 64-bit processor executes instructions in 64-bit chunks, it is ideal for complex calculations that require a high-level of precision. Applications can manipulate large amounts of complex data easily and more reliably.

What does this mean for developers?

- 64-bit eliminates the need for complex workarounds to 32-bit memory constraints while developing applications
- Huge Virtual and Physical Memory Increase on 64-bit platforms
 - Process Virtual Addressing space 2731x to 4096x larger
 - Physical Memory Max currently 8x larger
 - Non paged and Paged pool ~256x larger
 - Allows Solution of more complex problems

Your enterprise can therefore run 32-bit applications at high performance as well as 64-bit applications. For instance, video composition for motion picture work and modeling for scientific and financial applications will benefit greatly from memory-resident data structures available on 64-bit Windows® operating systems. So will an increasing percentage of enterprise business solutions, such as security applications and real-time transactional systems.

While some applications do not fit into a 32-bit computing model, others that may have outgrown a 32-bit environment suffer in performance. For example, limitations on file size in a 32-bit environment may require database systems to use multiple files to represent a single file. With 64-bit computing, your database managers can keep large files or entire databases immediately accessible in memory. Having this information readily accessible can significantly improve your company's response time. Microsoft® 64-bit Windows® operating systems are well suited to address the limitations of 32-bit architecture in a variety of deployment scenarios, including database, business applications, terminal services, Microsoft® Active Directory®, Web Server and technical computing workloads.

In addition to file size challenges, there are various reasons driving the move toward 64-bit computing. These include the ongoing explosion in data storage and access requirements, as well as the growing need for near real-time processes to improve customer service, productivity, regulatory compliance, and business transparency.

There are also new technologies such as Radio Frequency Identification (RFID) tags and point of sale devices that are causing a quantum leap in processing, capacity, and data requirements that may ultimately dwarf the end-user-related workloads we know today. As these trends converge, 64-bit computing capabilities will become increasingly important for a growing number of mainstream enterprise applications.

Why 64-bit?

- **INCREASED PRICE/ PERFORMANCE.** Over 170,000 registered developers in the Intel community strive to extract top performance on Intel-based platforms. As a result, the price/performance of Intel-based servers is unmatched by competing platforms in the market. Among published TPC-C (OLTP) benchmark results from the Transaction Processing Performance Council (TPC) as of May 2005, the top 10 price/performance results were all achieved by Intel-based servers while Intel/Microsoft were ranked #1 in Performance and P/P for TPC-W (web commerce).
- **LOWER COST OF OWNERSHIP.** Each server can support larger numbers of users and applications, so your business will require fewer servers. This translates directly into less management overhead—one of the highest costs in any computing environment.
- **NEW APPLICATION OPPORTUNITIES.** New applications can be designed without the barriers imposed by 32-bit Windows. New graphics applications will make work easier and more enjoyable. Data-intensive tasks that are impossible today can be done with 64-bit Windows.

Discover multi-core

Multi-core computing is one of the approaches microprocessor companies are betting on as they explore new ways of increasing processing power. Placing two or more powerful computing cores (CPUs) on a single processor die opens up a world of important new possibilities.

Dual-core processors are the first step in the transition to multi-core computing. Currently, most microprocessor makers etch dual processors onto a single slice of silicon, thus enabling servers to perform more work. Intel is already conducting research on architectures that could hold dozens or even hundreds of processors on a single die.

So why should you be excited about multi-core? Multi-core processors provide two or more complete sets of execution resources to increase overall compute throughput. This can significantly improve user experiences in multitasking environments by enhancing performance and enabling simultaneous processing of multiple tasks more efficiently. Numerous foreground applications can therefore run concurrently with a number of background applications such as virus protection and security, wireless, management, compression, encryption and synchronization.

Intel has been working with leading software vendors to enable multithreaded code that can take full advantage of the increased capabilities of multi-core processors. By using operating systems from Microsoft, customers take advantage of Hyper Threading and multi-core technologies while gaining deployment cost benefits as Microsoft licenses its operating systems on a per-socket basis rather than a per-core basis. This can lower the cost of adoption significantly when looking to scale system resources in the future. Extensive multithreading tools and resources have also been established to drive thread-optimization across a wide range of applications.

Planning your 64-bit course strategy

- Better performance for existing 32-bit applications
- Better performance and TCO for existing 64-bit applications
- Deploying new 64-bit enterprise solutions
- Selective 64-bit migration to maximize business value



If you are wondering when is the right time to migrate from your current 32-bit servers to 64-bit servers, there is no better time like the present.

Industry estimates suggest 2005 will be the year when, for the first time, the vast majority of new server hardware and high-end workstation shipments will be 64-bit capable.

*Don't waste money by migrating applications unnecessarily...
Know which of your applications will and won't take
advantage of 64-bit servers so you can prioritize which
applications to migrate first!*

Three factors are contributing to this shift: First, Intel's entire line-up of new server and workstation platforms are 64-bit capable - 64-bit Intel® Xeon™ processors based on the x86 architecture and Intel® Itanium® 2 processors based on the Explicitly Parallel Instruction Computing (EPIC) architecture. Second, the Windows platform will support both these 64-bit architectures. Third, organizations are increasingly viewing these platforms as a cost-effective alternative to the higher-priced, proprietary 64-bit architecture of RISC-based UNIX servers.

IDC's Server group forecasts that the market for Intel® Itanium® processor-based servers will grow from less than \$1 billion in 2003 to more than \$8 billion in 2008. This expectation is based on a ramp-up in Intel® Itanium® based Integrity servers by HP, which is basing its enterprise server line on Intel® Itanium® processor, as well as increased shipments from other OEMs, including NEC, Hitachi, Groupe Bull, Unisys, IBM, and SGI.

IDC also expects that the entire software ecosystem will move to embrace 64-bit-capable computing in the coming years. The entry of 64-bit-capable hardware and software that carries little or no price premium for adding 64-bit functionality, and that offers full backward compatibility to older applications, represents a "tipping point" for 64-bit capable computing. This change opens up a viable path for customers to begin their move from 32-bit computing to 64-bit computing in earnest and across the board.¹

¹ IDC Insights: What Impact Will 64-Bit Computing Have on the x86 Software World? June 2004, IDC #31501, Volume: 1, Tab: Markets

Gartner research suggests that "by year-end 2006, at least 30 percent of new Microsoft® Windows® servers will be deployed with Microsoft® Windows Server™ x64 Editions (0.8 probability). Windows x64's share of the market will rise to at least 45 percent by year end 2007 (0.7 probability) and to at least 65 percent by year end 2008 (0.7 probability)."²

Enterprises will move to 64-bit for two reasons: financial savings and operational improvement. On the performance front, certain functions will definitely benefit greatly from 64-bit operations, but it is equally certain that other tasks will see little, if any, improvement in performance from a switch to 64-bit.

But before you migrate, do consider this:

All 64-bit applications and workloads are not the same. Data, processing, and RAS requirements can vary dramatically. In any implementation, it is therefore vital to clearly determine workload and business needs, and to craft a best-fit solution that balances reliability, cost and performance.

For example, an enterprise resource planning (ERP) application, may require less total compute and data resources, yet failure or slow response times may impact thousands of users and cost millions of dollars per minute.

On the other hand, a complex engineering application may access terabytes of data and consume vast processing resources. Yet response times are typically not critical and an isolated system failure may not be catastrophic.

Forrester Research Inc. notes "the impact is compelling. Now they [businesses] can deploy 32/64-bit systems at almost no cost penalty, which will allow them to gradually migrate to 64-bit through a three-stage process involving a progression from pure 32-bit software, to 32-bit applications under 64-bit operating systems, and ending with pure 64-bit environments with minimal disruption and risk."³

64bit Functionality Benefits

→ RDBMS	→ Data mining
→ Scientific computing	→ ERP/Manufacturing/Process modelling
→ Data modelling	→ Shared application hosting
→ Physical system simulation	→ Server consolidation
→ CAD/CAE	
→ Imaging	

² Analytical source: CIO Update: The Shift to 64-bit Windows Server Computing Begins by John Enck, Gartner Research

³ http://www.intel.com/business/bss/products/server/64-bit_tipping_point.pdf

Better performance for existing 32-bit applications

OPTION 1: UPGRADE YOUR PLATFORMS NOT YOUR SOFTWARE

Legacy mode for traditional IA-32 deployments (32-bit OS/32-bit applications)

For applications that currently need not more than 4GB of memory, migration to 64-bit software may not be the best solution. An alternative strategy would be to upgrade your servers, adding additional servers or increasing the size of your servers (e.g. moving from 2-processor to 4-processor systems).

Today’s platforms based on the 64-bit Intel® Xeon™ processor include a variety of innovations that can improve performance by as much as 50 per cent or more, even for existing 32-bit applications.⁴

A simple platform upgrade may substantially improve performance especially if you are replacing a three to five year old server. You may also benefit from a variety of technologies that can help reduce your TCO, through improved manageability and power savings.

OPTION 2: RUN EXISTING 32-BIT APPLICATIONS ON 64-BIT OPERATING SYSTEMS

Compatibility Mode for running 32-bit applications in 64-bit environments (64-bit OS/32-bit applications)

On a traditional 32-bit platform, the OS and all the applications typically share the available 4GB of memory. In most cases, the OS reserves about half of this total memory for itself. By running existing 32-bit applications on a 64-bit OS, you can provide 4GB of memory for each application. No code changes are needed for the application itself, but 64-bit device drivers are required.

Migration flexibility is the key advantage of this mode. It enables 32-bit and 64-bit applications to run concurrently on the same platform. Migrations to 64-bit can therefore be performed incrementally, component by component, based on performance and cost.

OPTION 3: PORT EXISTING 32-BIT APPLICATIONS TO 64-BIT

Full 64-bit mode for running 64-bit applications (64-bit OS/64-bit applications)

This mode delivers the full memory advantages of a 64-bit solution, but existing 32-bit applications must be ported to 64-bits and optimized to achieve full benefits. Memory capacity is greatly enhanced with up to 1TB for platforms based on the 64-bit Intel® Xeon™ processor and up to 1 PB (1,000 TB) for platforms based on the Intel® Itanium® 2 processor.

⁴ <http://www.intel.com/business/bss/products/server/64%2Dbit/ -- Migration Strategies>

To take advantage of 64-bit application support, you must have a complete 64-bit system (server, OS, applications and drivers) in place. While existing 32-bit applications are supported without conversion in this environment, they cannot take advantage of 64-bit addressing and the associated memory capacity.

For those applications that will ultimately require more robust 64-bit support, this can be seen as an interim stage in moving toward the higher performance, scalability, and RAS of an Intel® Itanium® architecture-based solution.

As reported by IDC: “Software revised and recompiled for 64-bit Intel® Xeon™ processors will be an important step closer to running on platforms using Intel® Itanium® processors.” Once an application is ported to 64-bit, it is relatively easy to port between the two architectures.⁵

While actual performance depends on specific applications and platform configurations, Intel has seen performance gains well above 50 per cent for selected applications in internal tests. Typical gains have been in the 10 to 40 per cent range.

Operating modes for Intel® Xeon™ and Intel® Itanium® 2 architectures

Platforms	Legacy Mode	Compatibility Mode	Full 64-bit mode
64-bit Intel® Xeon™ processor	32-bit OS 32-bit Applications 32-bit Drivers	64-bit OS 32-bit Applications 64-bit Drivers	64-bit OS 64-bit Applications 64-bit Drivers
Intel® Itanium® 2 processor		64-bit OS 32-bit Applications running on IA32-Execution Layer 64-bit Drivers	64-bit OS 64-bit Applications 64-bit Drivers

Advantages and platforms of choice for operating modes based on Intel’s 64-bit platforms

	Legacy Mode	Compatibility Mode	Full 64-bit mode
Key advantages	Low cost, low risk, no need for software migration	Ideal for memory- constrained 32-bit applications; No need to migrate application code	Ideal for applications with intense memory requirements
Platform of choice	64-bit Intel® Xeon™ processor -based system	64-bit Intel® Xeon™ processor-based system	64-bit Intel® Xeon™ processor- based system for mainstream applications Intel® Itanium® 2 processor-based system for demanding, business critical applications

⁵ http://www.intel.com/business/bss/products/server/64-bit_tipping_point.pdf

Better performance and TCO for existing 64-bit applications

Most existing 64-bit applications are high-volume, business-critical, data-tier solutions that often run on expensive, proprietary RISC and mainframe systems. Intel® Itanium® 2 processor-based platforms deliver high levels of performance and reliability for mission critical applications in the areas of database, business intelligence and Enterprise Resource Planning in the market segments traditionally served by RISC. When assessing the value of transitioning to Intel architecture, consider:

- Performance, cost and capacity limitations of your existing RISC based systems
- Challenges of scaling, extending and integrating your broader application environment
- Availability of OS, application and tools
- Your migration costs versus TCO over the life of the solution

Deploying new 64-bit enterprise solutions

If you are deploying off-the-shelf applications, you need to closely examine the workload and business requirements and how they relate to specific platforms.

Microsoft® Windows Server™ 2003 on Intel® Itanium® 2 processor-based platforms delivers high levels of performance and reliability for mission critical applications in the areas of Database, Business intelligence and ERP in the market segments traditionally served by RISC/UNIX. Since it is based on Explicitly Parallel Instruction Computing (EPIC) technology, which incorporates highly parallel processing and compiler-based optimization that improves performance for compute-intensive applications, Itanium® architecture is an ideal choice for high-end 64-bit computing.

64-bit Intel® Xeon™ processor-based systems with the new Windows Server™ 2003 64-bit Editions offer superior price/ performance support for general purpose applications, such as Web and mail infrastructure, mechanical computer aided design, and electronic design automation; and for mixed environments in which optimized 32-bit performance remains critical. Based on x86 architecture, Intel® Xeon™ processors are a natural migration of Intel's 32-bit server architecture to 64-bit, with additional architectural features (including instructions and registers) that expand memory addressability and allow you to run both 32-bit and 64-bit operating systems and applications.

Intel and Microsoft offers detailed platform recommendations, professional consulting and extensive software tools for software optimization on all Intel-based platforms from Intel® Solution Services.

Selective 64-bit migration to maximize business value

To optimize business value and reduce risk, you will need to develop an enterprise-wide 64-bit migration strategy.

1. Evaluate and classify your critical workloads
2. For each category, assess migration strategies on specific business variables such as TCO, risk and change management
3. Provide headroom for growth as appropriate.

In planning your migration, be aware that:

1. While full 64-bit migrations can be resource intensive, you can take advantage of expected performance improvements with Intel® multi-core processors supported by Microsoft® operating systems and applications
2. Porting between Intel® Xeon™ processor-based systems (32-bit) and Intel® Itanium® architecture (64-bit) is quite straightforward
3. Intel plans to establish a common platform architecture for both microprocessor families by 2007
4. Proven Intel and Microsoft 64-bit computing solutions offer investment protection, flexibility, choice and outstanding price/performance
5. Microsoft® operating systems and applications optimized for 64-bit computing increase server throughput and utilization, lower TCO, and improve security protection with virtualization, manageability and I/O acceleration technologies.

Acknowledging the multi-faceted nature of business operations today, Intel offers two processor architectures for enterprises, providing customers with the agility and flexibility to integrate various business processes and deliver high quality services. Intel® Itanium® architecture, which is designed for the most demanding and business-critical enterprise and technical applications, offers a cost- effective RISC replacement option.

64-bit Intel® Xeon™ processor-based platforms, though not equivalent to Itanium® architecture in terms of capacity, performance and RAS, enable a more gradual migration to 64-bit solutions, since they provide native support for existing, legacy 32-bit applications. It is important to note that both platforms will be needed in most enterprise computing environments.

Understanding the Advantages between Intel's 64-bit solutions

	64-bit Intel® Xeon™ Processor-based Platforms	Intel® Itanium® Processor-based Platforms	Advantages of Itanium Versus IA-32 Architecture
Performance	<ul style="list-style-type: none"> Outstanding price/performance for 32-bit applications Ideal for gradual, pay-as-you-go migration to 64-bit 	<ul style="list-style-type: none"> Exceptional performance for high-end 64-bit applications Compatible with 32 bit applications 	<ul style="list-style-type: none"> Itanium architecture typically delivers 30-50 percent better performance. The advantage tends to be greatest for floating-point-intensive and business-critical data tier workloads
Scalability	<ul style="list-style-type: none"> Scales to 64-way 	<ul style="list-style-type: none"> Scales to 512-way, with larger platforms on the way 	<ul style="list-style-type: none"> The performance advantage of Itanium architecture increases substantially in large, SMP configurations: <ul style="list-style-type: none"> 4-way servers: ~35% better 32-way servers: ~140% better
Memory Addressability	<ul style="list-style-type: none"> Up to 1TB 	<ul style="list-style-type: none"> Up to 1PB (1,000TB) 	<ul style="list-style-type: none"> Itanium architecture scales to support the largest platforms and enterprise data sets
RAS	<ul style="list-style-type: none"> High reliability, with on-chip features such as memory spares, Chipkill* memory, and error correction (ECC) 	<ul style="list-style-type: none"> Additional on-chip reliability features, such as Enhanced Machine Check Architecture (MCA); Pellston* technology will be supported in next-generation processors 	<ul style="list-style-type: none"> Itanium architecture delivers high-end RAS for core, business-critical applications, making it ideal for mainframe and high-end RISC replacement
Platforms	<ul style="list-style-type: none"> Balanced bandwidth and high performance for a wide variety of workloads 	<ul style="list-style-type: none"> Greater bus bandwidths and enhanced support for large symmetric multiprocessing (SMP) configurations 	<ul style="list-style-type: none"> Platform manufacturers tend to offer more advanced platform options for Itanium architecture-based systems, targeting high-end, business-critical data tier environments

^a This table is based, in part, on information reported in *Intel's Enterprise Processor Plans: Positioning the Xeon Processor and the Itanium Processor*, by Vernon Turner, IDC, April 2004; available on the Intel Web site at: http://www.intel.com/technology/64bitextensions/4071_Intel_xeon_rev3.pdf

^b Though this is generally true, actual performance will depend on specific workloads and configurations, and Intel Xeon processor-based systems may deliver better performance in select cases.

* The first dual-core Intel® Itanium® 2 processor, codenamed "Montecito," due in 2006, offers improved reliability with Pellston technology for error detection.

EVALUATING COST EFFICIENT RISC/UNIX REPLACEMENT - Intel® Itanium® 2 based servers running Microsoft® Windows Server™ 2003

If you are already on a 64-bit proprietary RISC platform, consider the following while evaluating your migration to 64-bit computing. Intel® Itanium® architecture was built from the ground up for high-end 64-bit computing in business-critical environments. Based on EPIC technology, it incorporates highly parallel processing and innovative, compiler-based optimization that greatly improves performance for

compute-intensive applications. With these capabilities, Intel® Itanium® 2 processor-based systems are delivering outstanding performance for some of today's largest and most demanding workloads, and for technical and scientific applications requiring high-performance floating-point calculations.

Systems based on the Intel® Itanium® 2 processor family:

- ➔ **ARE MORE COST-EFFECTIVE:** Itanium® 2 servers can boost application performance at one-third the cost of RISC and provide broader multi-vendor choices. In fact, today nine of ten RISC vendors have adopted the Intel® Itanium® 2 processor to expand choice and flexibility and lower cost over proprietary RISC offerings.
- ➔ **ARE ESTABLISHED AND PROVEN:** Itanium® 2-based servers are proven, with deployments in more than 40 per cent of Global 100 companies and inspire world-class solutions and extensive optimization programs in an industry-standard architecture.
- ➔ **OFFER SUPPORT FOR YOUR BUSINESS SOLUTIONS:** The OS, application, and system choices for Itanium® 2-based systems vastly outnumber those for RISC systems. Itanium® 2-based server software availability continues to grow, with more than 4,100 applications and tools available today including Microsoft® SQL Server™. Operating system support includes Microsoft® Windows Server™ 2003 Enterprise and Datacenter Editions.
- ➔ **OFFER INCREASED PRODUCTIVITY FROM EXCEPTIONAL PERFORMANCE:** Itanium® 2-based systems demonstrated top TPC-C performance for Microsoft® Windows® operating systems and SQL Server™ applications. New capabilities in Microsoft® Windows® 2003 Editions offer a strong step toward addressing the major RAS features that were traditionally featured on UNIX servers, while offering a more competitive price/performance value proposition.

"We're supporting both the X86 architecture and we continue to have support for the Itanium® 64-bit architecture. In some very high performance demanding cases, the Itanium® really shines in a unique way. We've put a big investment in that working with Intel and we're very committed to have that as part of the overall 64-bit strategy."

- **Bill Gates**, Chairman and Chief Software Architect, Microsoft Corporation

Dataract, an Australian company specializing in business process management software, has taken a new approach to workflow. Their flagship product, Dataract e5 Human Workflow software is based on Microsoft infrastructure software and Intel architecture-based servers.

Using traditional workflow software based on UNIX to run on RISC-based platforms is costly to develop, install, integrate, maintain, and update over time. This combination has simply priced workflow out of consideration for many companies. By using cost-effective Intel® architecture-based servers, Dataract e5 Human Workflow reduces the cost of a typical business process management installation by approximately one third to half of the cost of traditional systems.

Van Zeyl, CEO of Dataract says, “The price/performance advantages of Intel® architecture-based servers compared to RISC servers provide us with a competitive advantage.” Tests showed that a one-tier environment with servers based on Intel® Xeon™ processors comfortably accommodated 100 users and moving up to a three-tier configuration with both Intel® Xeon™ and Itanium® processors, this increased to 1,000 users. Scaling up to several multi-processor application servers set up in a SharePoint farm, a single business logic server, and a very large Itanium 2-based database server was predicted to accommodate more than 5,000 users.

CONSIDERING A PLATFORM THAT SUPPORT A BROAD RANGE OF APPLICATIONS-

64-bit Intel® Xeon™ processor-based servers with the new Microsoft® Windows Server™ 2003 x64 Editions

Microsoft® Windows Server™ 2003 x64 Editions help you unlock the capabilities of 64-bit Intel® Xeon™ processor based servers.

- ➔ Grow your business with increased memory support, operating system and application headroom for today's business applications, while offering a smooth transition to 64-bit computing.
- ➔ Enhance performance of your 32-bit applications using new Windows Server™ 2003 x64 Editions optimized to take advantage of Hyper-threading technology, PCI Express and DDR2-400 memory available on 64-bit Intel® Xeon™ processor-based platforms.
- ➔ Maximize server availability and improve data security protection through a combination of the latest Windows support for the Intel Execute Disable Bit.
- ➔ Take advantage of power management features enabled in Windows Server™ 2003 x64 Editions to reduce your utility costs by up to 24 per cent with Intel's Demand Based Switching technology.

Intel and Microsoft continue to innovate to deliver improved server throughput, utilization and security protection through close collaboration on multi-core and Intel Virtualization Technology. The result is that users will be able to achieve

optimized application performance and outstanding business value with innovative Intel platforms architected for dual core.

Given the flexibility of this approach, the industry migration to 64-bit is likely to be a gradual and selective process. Most software developers will begin by validating their existing 32-bit applications for 64-bit operating environments; and migrate the code if and when it makes sense based on workload requirements and market demand. Your migration strategy should also factor the transition to multi-core computing, as it seems inevitable when you consider the inherent benefits. Multi-core processors offer fundamental advantages but their value must be considered within the context of your business needs, broader IT initiatives such as virtualization, deploying new technologies and applications, as well as upgrading your security.

Embarking on a 64-bit journey

What to consider while selecting your platform?

- Categorize your applications for 64-bit computing
- Choose the right 64-bit Operating System environment
- Check your database layer



Once you have decided to embark on your journey towards 64-bit computing, selecting the right platform is probably the next most important decision that needs to be made. This decision involves several factors; evaluating your current computing environment, categorizing application types and workloads, identifying compatibility issues and performance to price consideration among other things. IT managers need to be sure that their 64-bit platform choice delivers lowest TCO as well as the best ROI.

Ensure your 64-bit computing environment provides extra headroom for your current and future business applications by standardizing your IT environment.

Categorize your applications for 64-bit computing

Categorizing your application workloads and determining how your front-tier, mid-tier or data tier applications benefit most from 64-bit capabilities is vital. They can all benefit but based on the workload considerations and your existing computing environment, you can choose between using a 64-Bit Intel® Xeon™ processor and Microsoft® Windows Server™ 2003 x64 Edition combination or a native 64-bit platform combination of Itanium 2 processor running on Microsoft® Windows Server™ 2003.

Enterprise computing solutions are complex, and there will always be exceptions to general recommendations. With that caveat, the following rule of thumb provide a useful starting point for planning migrations and selecting platforms. When in doubt on the need for 64-bit, consider deploying 64-bit capable platforms to lay the foundation for migrating if and when needed.

Front-end Workloads and General Purpose Infrastructure Applications

Many front-end applications do not require 64-bit capabilities and scale very well across multiple servers. This tends to be true for Web, email, customer relationship management, and some supply chain management solutions. Depending on processing loads and data sets, it may also be true for more demanding applications, such as digital content creation, mechanical computer-aided design, and electronic design automation. In general, unless there are specific workload considerations, Intel® Xeon™ processor running on Microsoft® Windows Server™ 2003 based systems are likely to provide the most cost-effective solution in these categories.

Mid-Tier Workloads

These applications are more varied in their requirements. Many will benefit from both 64-bit capabilities and from the migration flexibility of 64-bit Intel® Xeon™ processor-based platforms. Some will require the greater capacity and compute power of Intel® Itanium® architecture. Software availability and vendor optimizations will likely be deciding factors for packaged applications. For custom code, it will be especially important to look closely at transaction loads, data requirements, growth expectations and migration costs.

Data Tier Workloads

Large data sets and heavy processing loads are more usual for these types of applications. Examples include enterprise databases, enterprise resource planning (ERP), supply chain management (planning), computer assisted engineering, and business intelligence. In general, these applications will perform and scale more effectively on Intel® Itanium® 2 processor-based systems and will also benefit from the enhanced set of RAS features. Applications currently running on mainframes and UNIX and RISC-based systems should be considered prime candidates for migration to platform running Intel® Itanium® 2 processors with Microsoft® Windows Server™ 2003 for Itanium®-based system architecture.

Choose the right 64-bit Operating System environment

Intel and Microsoft have invested significantly not only in hardware integration and optimization but also in the development of the largest range of solutions that take advantage of 64-bit processing to deliver compelling value to enterprises of all sizes. The Windows Server™ System integrated server software helps organizations scale up beyond the limits of the 32-bit x86 architecture, with support for up to 64 processors and 1 TB of memory.

The Windows Server™ 2003 family supports two different 64-bit architectures. The first 64-bit architecture is based on Explicitly Parallel Instruction Computing (EPIC) and supports the Intel® Itanium® processor platform family. The second 64-bit architecture is based on 64-bit extensions to the x86 instructions set and supports Intel Extended Memory 64 Technology (EM64T), found in the latest Intel® Xeon™ and Pentium® processors. Windows Server™ 2003 x64 Editions support this architecture.







With the release of Windows Server™ 2003 x64 Editions and Microsoft® Windows® XP Professional x64 Edition, customers now have an industry-standard platform that combines the power of 64-bit processing with the largest base of applications in the industry. Application vendors are poised to provide supporting, native x64 applications, and Microsoft® Visual Studio® 2005 will further simplify the creation of

While choosing a 64-bit operating system environment, you need to bear in mind whether the operating environment you choose has all the required features, functions and characteristics needed to service information flow in your current IT set-up, and can also grow with support capability for future platform enhancements

64-bit Windows applications with an integrated development environment that also supports the Intel® Itanium® processor family.

Adoption of Windows Server™ 2003 x64 Editions is appropriate for workloads for which its scalability, very large memory support, and performance will provide immediate improvements for the customer. These key targeted workloads are normally “infrastructure loads” and can include the following deployment scenarios:

Windows Server 2003 Family

			
	32-bit x86	64-bit x64	Full 64-bit Itanium
	Up to 32 way, 64 GB RAM	Up to 64 way, 1TB RAM	Up to 64 way, 1TB RAM
	Up to 8 way, 64 GB RAM	Up to 8 way, 1TB RAM	Up to 8 way, 1TB RAM
	Up to 4 way, 4 GB RAM	Up to 4 way, 32 GB RAM	n/a
	Up to 2 way, 2 GB RAM	n/a	n/a

→ DATABASE SERVER

By moving the database server from 32-bit Windows to Windows Server™ 2003 x64 Editions, you gain not only virtually unlimited virtual memory address space but also support for more physical memory, and in a flat memory model that provides the fastest possible access.

→ LOB APPLICATIONS

The move to x64 gives the LOB application a full 8TB of virtual memory address space and support for up to 1 TB of physical memory. This allows very large data sets to be directly addressed, speeding up the application and improving reliability and scalability.

→ TERMINAL SERVICES

Moving to an x64 system allows the operating system more virtual address space, a much larger PTE (128 GB instead of 600 MB to 900 MB), paged and non-paged pools (128 GB each instead of 470 MB and 256 MB, respectively), and a full 32 GB of RAM in Windows Server™ 2003 Standard x64 Edition as compared with only 4GB in the 32-bit edition.

→ ACTIVE DIRECTORY

Moving very large Active Directory deployments to Windows Server™ 2003 x64 Edition enables the Active Directory to be fully resident in memory and directly addressed. Limitations imposed by the 2GB of virtual memory address space are removed, and the improved I/O buffering and in-memory queries remove the excessive load on the I/O subsystem.

→ WEB SERVER

By moving an existing IIS 6.0 ASP.NET application to an x64 environment, without any other changes to the application, the application automatically has a full 4GB of virtual memory space available. This can make a dramatic improvement in reliability and uptime of the application.

→ TECHNICAL COMPUTING

The 4 GB of virtual memory address space and 64GB limit of physical memory in 32-bit Windows Server™ 2003 is a significant constraint in a High Performance Computing (HPC) cluster. The increased virtual and physical memory supported in x64 editions of Windows Server™ 2003 improves the overall throughput of individual nodes in an HPC cluster.

“First Mover” workloads on Windows Server™ 2003 x 64 editions
(as compared to 32-bit)
Performance and Scale

Workload	Performance and Scale
64-bit Business Apps SAP	18% more users
64-bit Networking Record	7Gbit/sec transfer
64-bit File	111% higher user capacity
64-bit .Active Directory	2x higher throughput
64-bit .Terminal Services	170% more Users

32-bit Windows Server™ 2003 is a significant constraint in a High Performance Computing (HPC) cluster. The increased virtual and physical memory supported in x64 editions of Windows Server 2003 improves the overall throughput of individual nodes in an HPC cluster.

Check your database layer

In today’s enterprise environment, data in very large databases needs to be sifted through and analyzed very quickly. If you are an IT manager operating in one or more of the IT environments below, chances are that you could do with the performance enhancement and scalability afforded by 64-bit computing.

You manage:

- Large-scale e-commerce applications with a high level of concurrent users
- Large data warehouses and analysis applications
- Global-scale Web services that drive a high Online Transaction Processing (OLTP) workload
- Database and application server consolidation
- Hosting and datacenter solutions

Microsoft 64-bit solutions

2005

- SQL Server 2005
- Visual Studio 2005
- Commerce Server 2006
- Host Integration Server 2005
- BizTalk Server 2006
- Services for UNIX

2006-2007

- Windows “Longhorn” Server
- Exchange Server 12
- Microsoft Operations Manager
- Virtual Server v2
- Windows Server “Compute Cluster Edition”

For extensive database activities 64-bit Intel® Itanium® based servers work hand in hand with Microsoft®.

SQL Server™ 2000 (64-bit) is one of the most widely-used database platforms worldwide, to move more data into memory for faster processing. A wider system bus, a larger number of registers and caches, vastly increased virtual memory, and a faster processor provide key infrastructure benefits such as increased processing power and reduced query time for compute-intensive applications, that SQL Server 2000 (64-bit) takes advantage of, resulting in higher user productivity.

"We shipped nearly 10 million hard drives last quarter. Our new database solution built around Microsoft SQL Server 2000 Enterprise Edition and Windows 2000 Advanced Server moved those drives through production faster, with little waiting and no errors. That equates to tremendous business value."

Sin Chee Pang -
Senior IT Director, Asia, Western Digital

Microsoft® SQL Server™ 2000 Enterprise Edition (64-bit) database solution on Itanium® 2-based servers offers world-class performance, reliability and scalability on the hardware of your choice at lower costs than with restrictive proprietary solutions. Cost savings make it a compelling alternative to expensive Unix-based solutions. Several independent studies have shown that the TCO of managing a SQL Server based database system is significantly lower than that of competing products.⁶

SQL Server™ 2000 64-bit is built from the same code base as 32-bit SQL Server 2000. It is optimized for running on Windows Server™ 2003 on the Itanium® 2 processor. It takes advantage of the extended resources provided by the 64-bit operating system to enhance its performance in several ways, including the following:

- Large memory addressability (up to 32TB)
- Nearly unlimited virtual memory (up to 8TB)
- I/O savings due to larger memory buffer pools and caches

Microsoft® SQL Server™ 2000 64-bit is available in two editions: Enterprise Edition, for application deployment, and the Developer Edition, for development and evaluation.

"We've committed to the Itanium processor family, and the Itanium processor family is the scale-up solution for the most demanding database and line-of-business applications running on Windows."

- **Bob Muglia**, Senior Vice-President for
Windows Server Microsoft

⁶ NerveWire Study, Strategic IT Initiatives: TCO Benefits of SQL Server

RECORD-BREAKING SQL SERVER 2000 (64-BIT) DATABASE PERFORMANCE ON THE ITANIUM 2 PROCESSOR

World's best SMP TPC-C result:

64-way Itanium 2-based server from HP achieved TPC-C benchmark result of 658,277 tpmC with a price/performance of US \$9.80/tpmC.

World's best 32P TPC-C result:

Itanium 2-based server from NEC achieved TPC-C benchmark result of 514,035 tpmC with a price/performance of US \$11.50/tpmC.

Future Proof Your Solution with Microsoft® SQL Server™ 2005

SQL Server™ 2005 will be the largest release of SQL Server™ to date and it will be the most dependable and secure release as well with more than 1,000 new and improved features. The next-generation of SQL Server™ will bring fundamental advancements in three key areas: enterprise data management, programmability, and business intelligence.

SQL Server™ 2005 will also bring significant improvements in programmability and ease-of-use to developers. Database developers now benefit from the ability to program in multiple languages and utilize integrated XML development and a source control environment. The SQL Server developer will experience all of the industry-leading features of Visual Studio .NET at the database level.

Building on the flexible approach delivered with SQL Server™ 2000, SQL Server™ 2005 supports implementations ranging from multi-terabyte data warehouses to mobile devices running Microsoft® SQL Server Windows CE Edition (SQL Server CE). And, SQL Server™ 2005 supports 64-bit computing on both Intel® Itanium® processor family and 64-bit Intel® Xeon™ processor-based platforms. Today, Microsoft has a licensing policy with SQL Server that favors multi-core licensing done per socket.

Developing and porting applications for 64-bit computing



The migration process from 16-bit to 32-bit was often a carefully considered challenge. Details such as pointer alignment, type sizes, function entry points, API changes and library call models made it a complex and error-prone proposition. Now, by moving from 32-bit to 64-bit, some changes are necessary but they are far fewer and less significant than the changes in moving from 16-bit to 32-bit.

For instance in a C/C++ environment:

1. The memory model remains the same (base data types remain the same).
2. There are no entry point issues.
3. The focus is on pointers and derived types, which are now 64-bit.

Additionally there are some new types of memory models that take advantage of the 64-bit architecture such as INT64, LONG64, etc. But because the base types remain unchanged, the impact to the developer's code base in migrating to 64-bit is minimal.

"We ported the latest version of our applications to Windows Server 2003 64-bit Edition on Itanium because we need a cost-effective 64-bit platform and hardware solution."

Alex Boyd -
Platform Development Manager, AREVA

Intel and Microsoft provide a range of software tools and development environments that are optimized to run on the latest 64-bit platforms. This strategy simplifies the developer's migration path considerably while also allowing the developer both to continue to utilize the extended capabilities of 64-bit data types and to break the 32-bit 4GB barrier.

Before developers begin porting their applications, there are essential questions to consider:

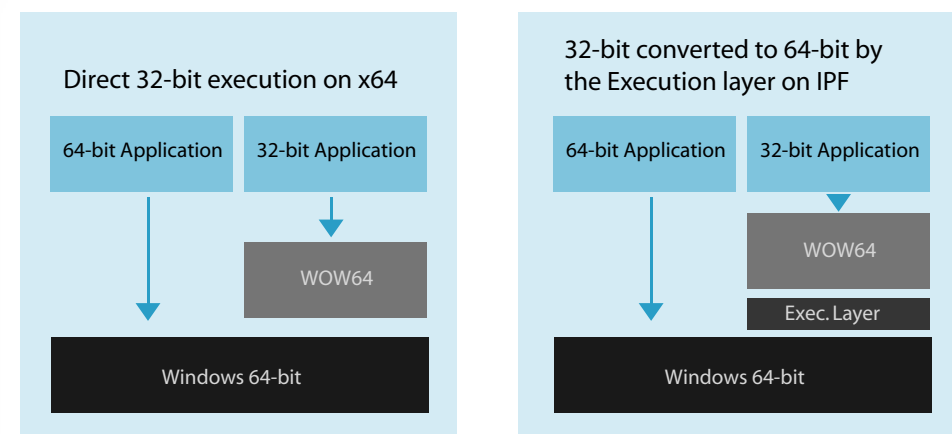
- How will the architecture of the application impact the migration?
- What integrated technologies will need special attention?
- Are there any third-party dependencies that need to be ported?

Keep in mind that 64-bit processes cannot load 32-bit libraries or DLLs. In contrast to the migration of 16-bit to 32-bit, it is not necessary to port all 32-bit code to

64-bit. The developer should analyze carefully which parts of the application will benefit from 64-bit.

How can a 32-bit application run on a 64-bit system? The answer is WoW64: Windows On Windows 64-bit. WoW64 is often regarded as an x86 emulator, a subsystem, or an operating system layer. It is none of these. Rather, it is a specific set of three DLLs that allow the 64-bit operating system to seamlessly and transparently redirect requests from 32-bit applications to 32-bit-specific resources. It is intended to run 32-bit personal productivity applications needed by software developers and administrators.

32bit Application Support On 64-bit Platform



WoW64 launches and runs 32-bit applications seamlessly. The system isolates 32-bit applications from 64-bit applications, including preventing file and registry collisions. It supports both console and GUI applications, as well as service applications. The system provides interoperability across the 32/64 boundary for scenarios such as cut and paste and COM. However, 32-bit processes cannot load 64-bit DLLs and 64-bit processes cannot load 32-bit.

Migrating applications to Windows 64-bit technology delivers greater reliability, with systems that are less prone to failure due to memory leaks and other common problems.

Windows 64-bit delivers better performance, with systems that are typically much faster, allowing developers and IT professionals to meet performance targets with fewer systems to manage.

64-bit systems provide all the headroom that IT professionals need to grow with their businesses for the life of their hardware. Together SQL Server™ 2005, Visual Studio® 2005, and BizTalk® Server 2006, running on Intel 64-bit architecture offer a comprehensive data platform and tools platform that prepares organizations to meet the evolving demands of their business. Using this platform, businesses will be ready to deliver connected solutions faster and more efficiently; ready to make informed decisions, and ready to deliver the most demanding mission critical applications

Future proof your IDE with Microsoft Visual Studio .NET 2005

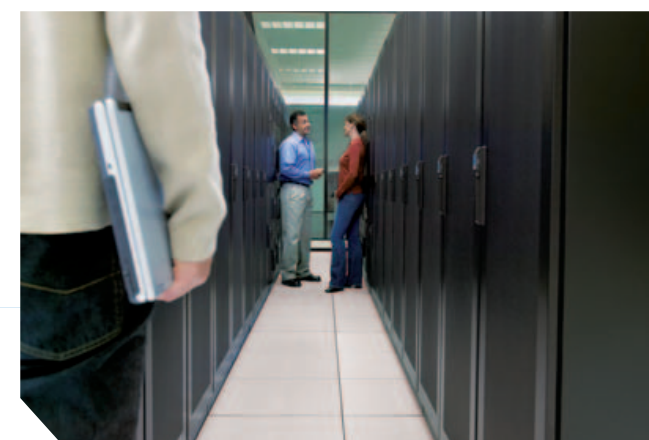
The release of Visual Studio® 2005 and the .NET Framework 2.0 will make strides in all dimensions of application development. First, Visual Studio® 2005 will set a new bar for developer productivity by tailoring the software development experience to the needs of the individual developer. This "personalized productivity" will deliver features across the development environment and .NET Framework class libraries to help developers overcome their most pressing challenges in minimal time. Second, Visual Studio® 2005 will enable developers to apply existing skills across a broader range of application development scenarios through improved integration with the Microsoft Office System™ and SQL Server™ 2005. Finally, Visual Studio 2005 will deliver a new set of tools and functionality that will help satisfy the application development needs of today's large-scale enterprises with its support for 64-bit Intel® Xeon™ processor-based platforms and Intel® Itanium® architecture based on EPIC technology.

More developer resources at:

Intel Software Network
<http://www.intel.com/software>

Microsoft Developer Network
<http://msdn.microsoft.com>

Enhanced support services for successful 64-bit migration



The key challenge facing many companies today is to maximize returns from existing IT resources and to be able to plan IT investments in a way that reduces the organization's TCO over time. Many organizations are seeking partners who can help them plan and optimize their IT infrastructure so that they are not burdened with ageing technology and do not end up spending more than they need to.

Intel® Solution Services and Microsoft can provide customers with the vital knowledge of Intel and Microsoft platform architecture needed by client organizations to deliver superior business results. The consultants have a breadth and depth of knowledge that spans all aspects of infrastructure including software applications, servers, clients, networking and communications.

They also work with customer organizations to understand the complexities of their IT infrastructures, help in identifying bottlenecks and work out cost effective solutions for their business requirements. This consultation is offered during the IT strategy development stage, and the solution deployment, implementation and Service Level Agreement stages. The team uses its in-depth knowledge of Intel and Microsoft architecture and next-generation technologies, as well as its key industry alliances, to design cost-effective, leading-edge solutions.

Intel provides a comprehensive set of software migration and optimization tools ranging from compilers, performance primitives, tuning analyzers, to threading and clustering tools. These tools are designed to deliver very deep code optimizations, while integrating seamlessly with leading development environments from Microsoft.

To help you plan your journey and identify solutions for your business, contact your local Microsoft or Intel Solution Services representatives:

<http://www.microsoft.com/worldwide/>

<http://www.intel.com/go/intelsolutionservices>

Proven customer success



Korea Telecom (KT)

KT deployed Intel® Itanium® 2 processor-based servers for database management and Intel® Xeon™ processors MP for wireless Internet and multimedia streaming services. It also ran a Microsoft .NET™ solution. These systems run the company's core network and business management operations including service deployment and customer service infrastructure. Development cycle time of new services improved by up to 30 per cent, enabling a much faster time-to-market. KT recorded an estimated 90 billion Korean Won (US\$77.83 million) in savings on man hours and equipment costs with the completion of the nationwide implementation. They were also able to improve the speed of response and information access for support staff greatly enhancing their customer care.

<http://www.intel.com/apac>

Fuji Photo Film Company Limited (Fujifilm)

Fujifilm moved to the powerful Intel® Itanium® 2 processor running on Microsoft® Windows Server™ 2003 (64-bit) Enterprise Edition and a Microsoft SQL Server™ (64-bit) database, gaining increased horsepower and avoiding the performance issues caused by the 32-bit memory limitations of Microsoft Windows™ NT. The new system exceeded performance goals, has proven reliable even under the most demanding workloads, and gives Fujifilm flexibility in adding capacity as demand increases. Query execution was up to 60 percent faster and the overall number of queries was cut in half with most queries performed in a single step.

<http://www.intel.com/business/casestudies/fujifilm.htm>

Koehler Group

The Koehler Group, the world's largest manufacturer of specialist paper, was able to streamline IT operations, minimize downtime, increase computing performance 20-50 percent, and reduce supply-chain tasks by 50 percent running Windows Server and SQL Server on Itanium® 2-based HP Integrity servers.

<http://www.intel.com/business/casestudies/koehler.pdf>

Raymond James Financial

Raymond James Financial, one of the largest financial services companies, was able to grow its data warehouse 15-20 percent annually while lowering costs by consolidating applications onto an Itanium® 2-based HP Integrity Superdome server with Windows Server and SQL Server.

<http://www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=14354>

FedEx Express

FedEx Express (FedEx), the world's largest express transportation company, moved from a UNIX-based analysis solution to Microsoft SQL Server™ 2000 Analysis Services which delivered a tenfold increase in performance and an 80 percent decrease in the cost of ownership. A subsequent upgrade to a 64-bit Microsoft® Windows operating system-based solution running on an Itanium® 2 –based server delivered an additional threefold performance increase and an 85 to 90 percent decrease in data load times.

<http://www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=16817>

AREVA

The Automation and Information Systems group of the Power Transmission and Distribution unit of multinational company AREVA needed to update its e-terraplatform suite of products for the electric power industry to run on a modern, cost-effective 64-bit computing platform. The e-terraplatform suite, which consists of roughly 3.5 million lines of code, chose to port the suite to Microsoft Windows Server™ 2003 64-bit edition, and completed the port in only 6 months. The suite achieves better than 99.95% availability using redundant hardware and application models.

<http://www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=16172>

Additional Information

